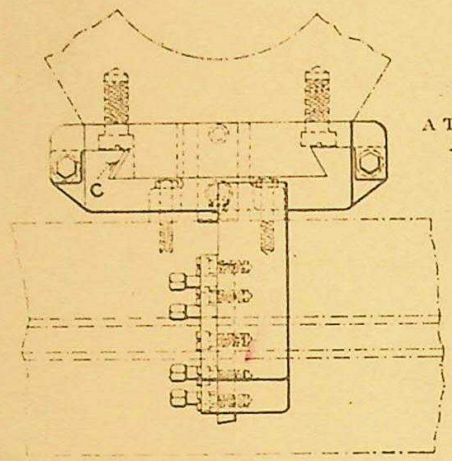
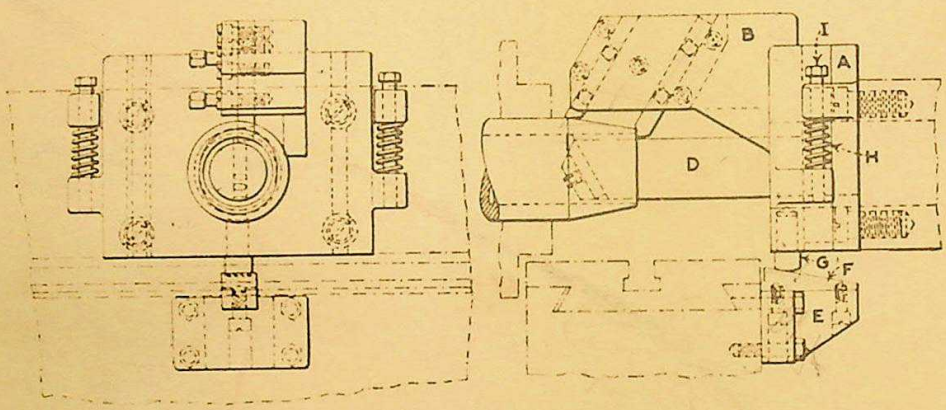
which are inserted between the lugs cast on *A* and *B*. The distance that part *B* can drop is limited by the screws *I* which pass through a clearance hole in the part *A* and are screwed into the lugs in part *B*. While this



A TAPER-TURNING ATTACHMENT FOR A P. & J. AUTOMATIC



action is taking place, the boring tool in bar *D* is boring a straight line in the work as shown.

The same idea was followed in rigging a tool for boring taper holes, with the exception that a boring bar holder was used in place of the overhanging arm. The results were equally as good.

Refinishing Anvils on Measuring Instruments

By W. C. Betz

The contact faces on measuring machines and the anvil and spindle end of micrometers need refinishing after a period of service.

The tools necessary are a small India oilstone, medium grade, ¼ x 1 x 4 in., and four cast-iron laps varying in thickness by 0.006 in., these latter pieces to be numbered from 1 to 4. The oilstone should be cleaned thoroughly with gasoline and lapped parallel on a piece of planed cast iron, using No. 1-F carborundum as an abrasive. The abrasive is sprinkled on the lap and the stone rolled over the grains. As soon as the charging material becomes dull or sticky it should be removed and new abrasive sprinkled on.

The set of cast-iron laps are ground parallel and charged with No. 3-F carborundum on one side only, using a hardened and ground block for the purpose.

It seldom happens that a micrometer or other measuring instrument is used until it is in such bad shape as to need regrinding, but if it should happen through neglect or injury, this should be done before attempting to lap.

The end of a micrometer spindle may be ground in a bench lathe by inserting the spindle of the micrometer through the rear end of the spring collet and grinding it with the regular attachment furnished with the lathe. The anvil can best be ground in place in the micrometer frame in a tool, or cylindrical, grinding machine by gripping a small piece of steel in the headstock chuck and grinding it so that the micrometer spindle bore wrings on it.

A saucer wheel is substituted for the regular grinding wheel and care should be exercised to insure that the cross-slide travels at exactly 90 deg. with the headstock spindle. The plug with the frame wrung upon it is turned so as to present the open side of the micrometer frame to the wheel and the headstock locked in position. The anvil is then ground by passing the wheel by the anvil face as in grinding a snap gage.

To finish the contact faces by lapping, the oilstone is laid on the charged side of one of the cast-iron lap pieces and the combination is inserted between the measuring faces of the tool and the lap is drawn in all directions to bring the whole stone surface into contact with the work. Care should be taken that the tension on the lap is just enough to hold the faces in contact, otherwise the tool will be sprung.

After one surface is roughed the lap is reversed and the other face is similarly treated, leaving the surfaces in a semi-finished condition. The oilstone is now removed and the cast-iron lap is used to finish the surface, reversing this so that the charged side comes into contact with each face in turn.

One of the laps is sufficient for lapping the faces of non rotating spindle instruments, including vernier calipers, but for micrometers and tools where one of the faces rotates it will be necessary to use the four laps alternately, both on the oilstone roughing and the finish lapping operation, for the following reason: To lap a rotating spindle instrument the oilstone is used with lap No. 1, and the anvil end cleaned of all wheel or wear marks. Piece No. 2 is next used, also on the anvil, and this lap is 0.006 in. thicker than No. 1. It follows that the spindle end of the instrument is in a position approximately 90 deg. from the first one and would quickly show whether or not the spindle end was parallel to the anvil by a few passes of the second lap.

By using all four laps it can be seen that different positions are presented with each lap, changing 90 deg. each time; which would show the difference beyond mistake by the cross lap marks on the anvil. The relation of the spindle face to the center line could be quickly determined, and by reversing the laps and using them on the spindle end this surface would soon be finished exactly square with the center line.

It might be necessary to use the laps alternately on the anvil and spindle end a number of times to bring the faces parallel, with the spindle in any position.

The idea of using the four laps is analogous to the three-plate method of finishing plane surfaces; if the anvil and spindle ends are parallel, the lap marks on these surfaces will show evenly by a few passes of all four pieces.